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Comparison of Lithium Disilicate and Zirconia as Restorative Materials

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Comparison of Lithium Disilicate and Zirconia as Restorative Materials : Literature Review

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References

INTRODUCTION

Metal ceramic restorations are a type of ceramic system for fixed prosthetic rehabilitation that has been widely used since the early 1960s [1-4]. Light reflects onto the opaque porcelain, masking the metal. A light grey appearance can be noticed, particularly at the cervical third. With this phenomenon in mind, researchers were led to explore a more aesthetic solution, while still maintaining mechanical properties. And as such, the excellent esthetic and mechanical properties of lithium disilicate and monolithic zirconia (MZ) have made them increasingly popular for clinicians who wish to provide their patients with minimally invasive, metal-free restorations [5].

OBJECTIVES

To compare lithium disilicate and monolithic zirconia as a restorative material. We aim to achieve this by assessing the materials and comparing them based on criteria's including tooth preparation, bonding techniques, optical and mechanical properties, clinical performance, biocompatibility, marginal fit and adaptation. Additionally, this review also compared the clinical outcomes of these materials in different types of restorations including full and partial coverage restorations.

METHOD

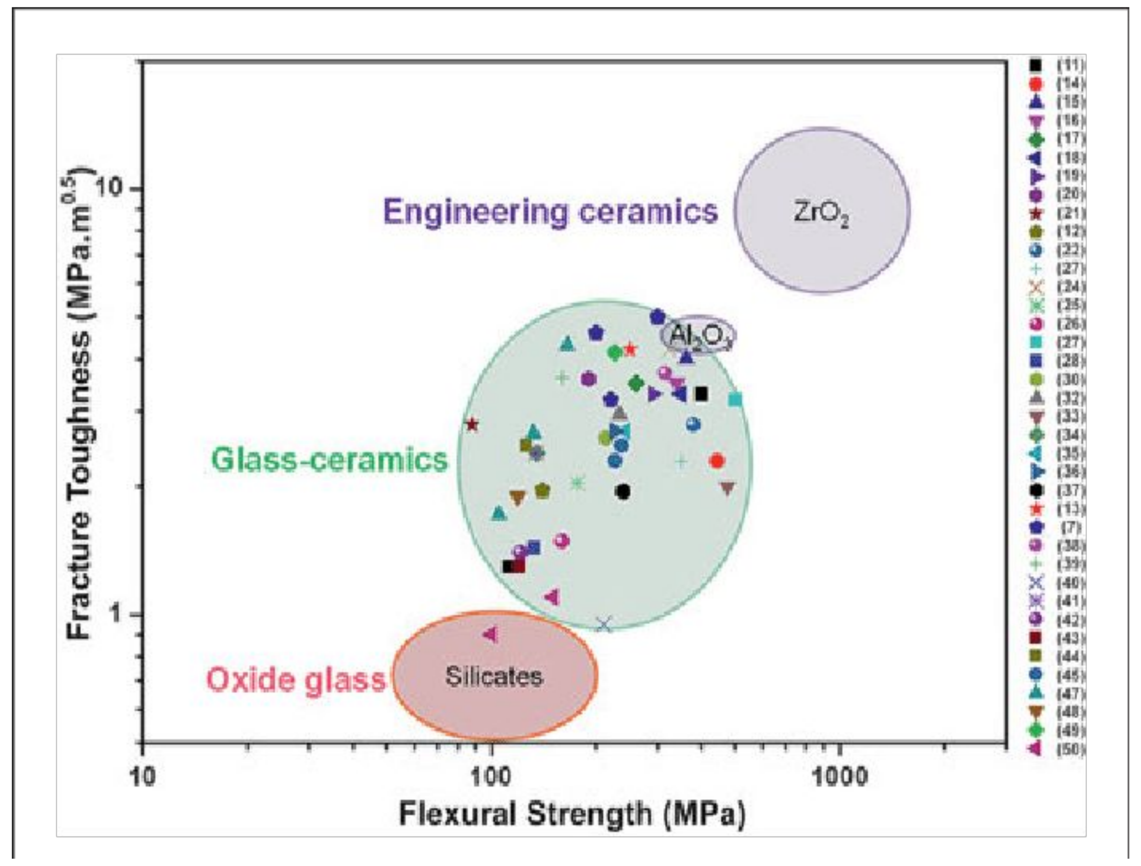
To perform the literature review, a search was performed on PubMed and Google Scholar for articles published between 1990 and 2024. Key terms were used; ‘lithium disilicate, monolithic zirconia, restorative dentistry. Additionally, information was gathered from a variety of internet sources, including articles and videos.

RESULTS

Mechanical

	Zirconia	Lithium Disilicate	Celtra Duo/Vita Suprinity (ZLS)	Tessera	Natural tooth (Dentin)
Flexural Strength	1100 Mpa	385.91 ± 46.23 Mpa	355.72 ± 72.44 Mpa	323.40 ± 61.01 Mpa	212.9 ± 41.9 Mpa
Fracture Toughness	7 MPa $m^{1/2}$	1.97± 0.12 MPa $m^{1/2}$	0.857±0.08 MPa $m^{1/2}$	0.93 ± 0.05 MPa $m^{1/2}$	1.244 ± 0.12 MPa $m^{1/2}$
Vickers Hardness test	17.76 GPa(approx)	5.97± 0.77 GPa	7.05± 0.73 GPa	7.19 ± 0.47 GPa	3.81 (approx)
Co-efficient of thermal expansion	10 - 11 x 10^-6/°C	10.6 x 10^-6/°C	7.05± 0.73 GPa	7.19 ± 0.47 GPa	10.59

- Zirconia demonstrates the highest strength, toughness, hardness, and thermal expansion among the listed materials.
- Lithium Disilicate offers moderate to high values across these properties, making it a suitable choice for dental applications.
- Natural tooth (Dentin) falls within the lower range of properties compared to synthetic dental ceramics, indicating the advantages of using modern materials for dental restorations



Optical:

Translucency:

Increasing Yttria mol% in the Yttria- Zirconia Continuum, increases the translucency, but decreases the mechanical properties.

LD had higher translucency than translucent multi-layered zirconia system.

TABLE 1

The 3, 4, 5 mole % Yttria-Zirconia Continuum

3 Y-TZP: Opaque Zirconia	4 Y-TZP: Largely Opaque	5 Y-TZP: Most Translucent
Highest mechanical properties	High mechanical properties	Lower mechanical properties
White opaque	Some translucency	Moderate translucency
Mainly tetragonal phase	Tetragonal and cubic phases	More cubic, less tetragonal phase

Sintering Temperature:

Shorter sintering time and higher sintering temperatures reported an increase in translucency.[7]

MZ ceramics should be sintered in a sintering temperature between 1400–1550 ◦C and no higher than that, as at temperatures of 1600 or 1700 ◦C grain boundary cracks can be generated, increasing light scattering and decreasing translucency [9]

Zirconia showed optimal masking ability against a normal dentin shade (ND3), acceptable masking ability against titanium at a minimum thickness of 1.5 mm, but could not mask severely discolored dentin at either 0.8 or 1.5 mm thicknesses.[9]

Zirconia couldnt mask severely discolored dentin (ND9), regardless of thickness. Decrease in zirconia thickness from 1.5 to 0.8 mm significantly increased translucency.

Dopants:

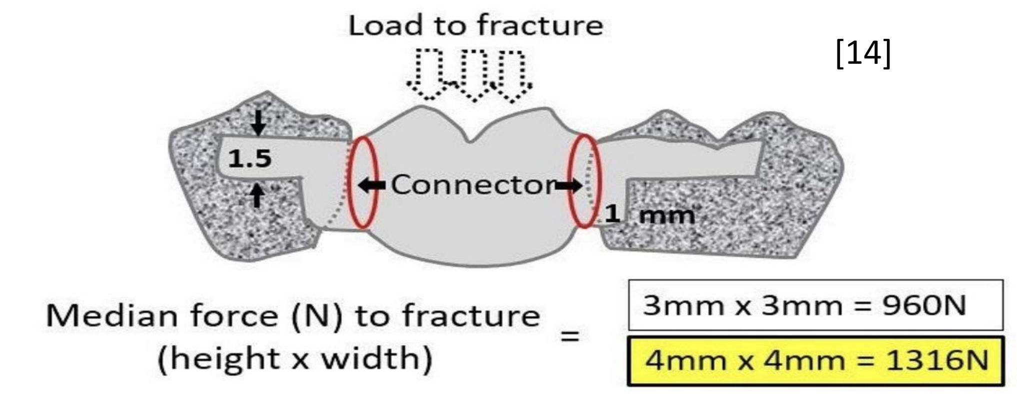
Translucency of the Y-TZP ceramics is associated with dopants employed in the chemical composition, eg; Al2O3.

In a study by Zhang et al.62) introducing 0.2 mol% La2O3 to 0.1 wt% Al2O3-doped 3Y-TZP yielded 42% higher translucency than conventional 0.25 wt% Al2O3-doped 3Y-TZP.

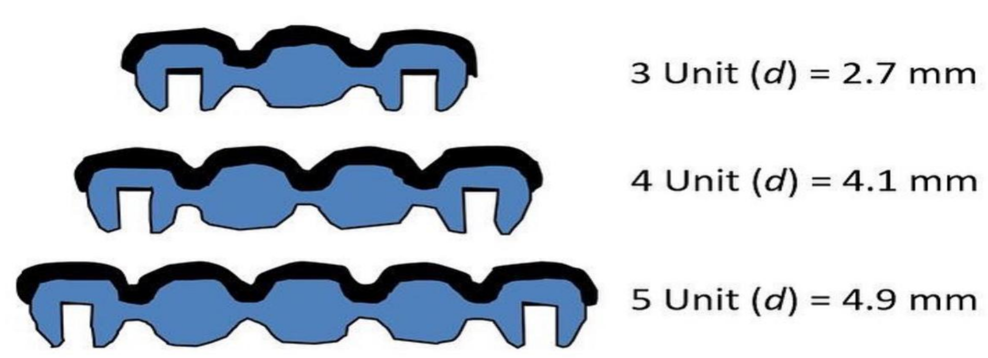
Clinical Performance:

- MZ and LDS crowns display a similar incidence of periodontal and endodontic complications compared to metal-ceramic crowns, suggesting that ceramic materials are viable alternatives.[10]
- Incidence of chipping was higher in LDS crowns compared to other materials.[12]
- Polished Z crowns are much less abrasive opposing enamel compared with LD.[17]

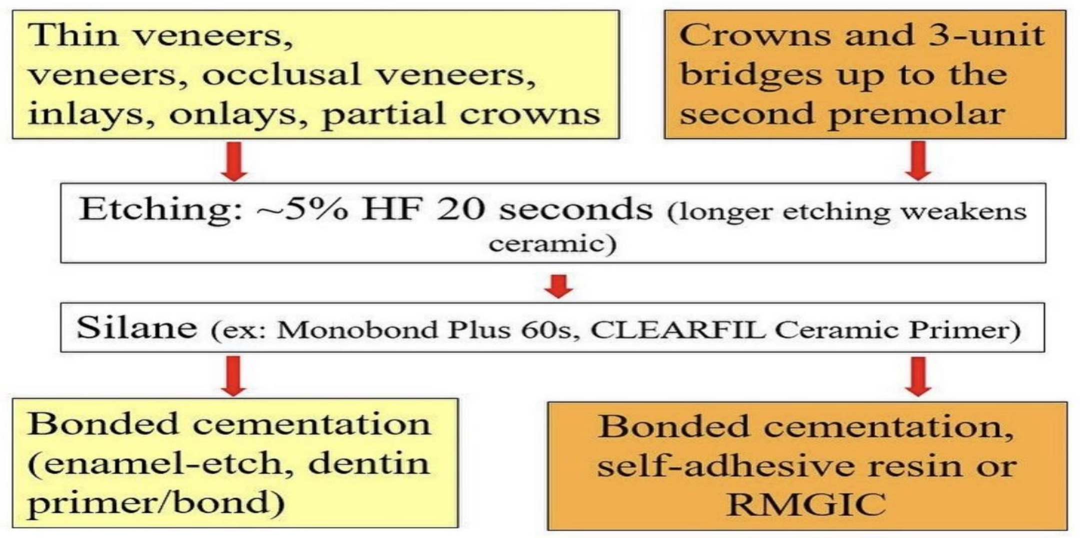
Fracture strength / lithium-disilicate connector size for FPD



Connector size for high strength zirconia frameworks [15]



Adhesive Strategies for Lithium-disilcates [16



Sandblasting with ALO2 at 1 atm, in combination with MDP based cements is the best cementation protocol for Z. ALO2 is very effective in surface roughening ,it improves adhesion between resin cements and Z. [18]

CONCLUSION

Zirconia: Undeniably the strongest of the ceramics with combination of mechanical and chemical properties. In presence of yttria, it has good optical characteristics and properties like self repiribility make it the material of choice for SCs, 3-4 unit bridges, implants, and bruxism patients. **Lithium Disilicate:** most versatile for its high esthetic potential, with translucency being almost 30% higher than zirconia, good mechanical properties and favoured bond strength to dental tissues, thanks to its silica content. Can be utilized both for tooth and implant supported restorations, ranging from SCs to FDPS, from anterior veneers to posterior onlays and inlays.

Bonding, tooth reduction, clinicians judgement, and other factors contribute to the longevity of the restoration.

ACKNOWLE-DGEMENTS

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OKU Sutro Excellence Day Project Cover Sheet

Project Title

COMPARISION OF LITHIUM DISILICATE AND ZIRCONIA AS RESTORATIVE MATERIALS

Full name(s) and class year(s) of all project collaborators

Example: Jane Smith, DDS 2022; John Smith, DDS 2022

NAVNEET KAUR KAINTH, OLA AL FAKHRI, NISHIT SACHDE (IDS 2025)

Project Category

IDS - 1st Year Literature Review

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Objectives: To compare lithium discilicate and monolithic zirconia as a restorative material.
Background: Zirconia and Lithium disilicate have been widely utilized in dental restorations for both partial and full coverage procedures, employing monolithic and layered methods. The aim of this literature review was to assess these materials and compare them based on various criteria, such as tooth preparation, bonding techniques, optical and mechanical properties, clinical performance, biocompatibility, marginal fit and adaptation. Additionally, this review also compared the clinical outcomes of these materials in different types of restorations including full and partial coverage restorations, implants, fixed partial dentures, and endocrowns.
Methods: To perform the literature review, a search was performed on PubMed and Google Scholar for articles published between 1990 and 2024. Additionally, information was gathered from a variety of internet sources, including articles and videos.
Results: The results indicate that tooth-supported crowns made by zirconia and lithium disilicate demonstrated similar mechanical properties, clinical performance, and survival rates across a range of scenarios. Material selection depends on position of the tooth in the arch, the functionality and retention required from the material to withstand occlusal forces.
Conclusion: After a comprehensive review of the available literature, it was concluded that the longevity/success of the restoration depends on a lot of factors like the material properties, bonding protocol, adequate tooth reduction, patient compliance, clinician's hand skills and judgment. Over the past few years, the advantageous qualities of ceramics have been increasingly recognized, and with the current advancements in bonding techniques in dentistry, these ceramics have the
capability to be considered as practical and durable options for patients.